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AUTHOR Balian, Edward S.
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ABSTRACT

Arguing that educators may be facing their greatest challenge in decades as they seek to integrate critical thinking techniques into the computer-assisted instruction (CAI) environment, this paper discusses the crucial importance of critical thinking and explores some potential adverse effects of CAI in this area. A brief historic overview of computers in education precedes the discussion of the importance of critical thinking, and a practical checklist for use in assessing the impact of CAI on critical thinking is provided. It is concluded that the key to the computer's optimum use as an instruction tool lies solely within the practices of the informed teacher. Seventeen references are listed. (Author/MES)

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TEACHING CRITICAL THINKING IN THE COMPUTER-ASSISTED INSTRUCTIONAL ENVIRONMENT

A paper presented at the
National Seminar on Successful College Teaching
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Orlando, Florida
March 8-11, 1987

Edward S. Balian, Ph.D.
Associate Professor, Quantitative Methods
Department of Management and Marketing
Division of Business and Computer Systems
Madonna College, Livonia, Michigan 48150

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Edward S. Balian, Ph.D.
Associate Professor, Quantitative Methods
Division of Business and Computer Systems
Madonna College, Livonia, Michigan

Few topics in higher education have received more attention than "Computer Assisted Learning" since the mid-1970's; but after all of our statistical evaluations and content analyses of computer "impact", have we maintained the ideal perspective? In this presentation, a discussion of computer-assisted instruction, as it relates to critical thinking, will be addressed.

A Historical Perspective

Circa 1958, many of us received our indoctrination to computers in ways which spotlighted the sophisticated research analysis potentials of, for example, "Univac." Next, John F. Kennedy's space program pushed computer development faster than perhaps anyone, less the space scientists, could have ever imagined. Consequently, by 1969, we educators had perhaps viewed the new computer technology as a largely scientific entity; its use in curricula, other than mathematical statistics and actual programming courses, was generally not broadly recognized.

The 1970's saw the advent of the "personal computer." Through vigorous marketing efforts, computer manufacturers made quick progress in education, citing "high-tech", "state of the art" and "cutting edge" technologies. Particularly at the elementary and secondary levels, what school district Empire could be caught short of such resources? At the college level, an argument could be made in that the computer influx was somewhat more realistic and utilitarian. But still, did we not seem a bit advanced in hardware and software, yet primitive in a teaching philosophy which could assimilate this grand technology into the true rudiments of learning?

Of course, minus the Madison Avenue puffing, computer technology really did change our teaching styles and, in many cases, course content. (As a postscript, did we educators really need ad campaign superlatives to evaluate this technology's potential pragmatic value to education and society?)

Change, Adjustment and Challenge

As with any change and growth, there is always a required adjustment. And sometimes the adjustments are difficult or resisted. The necessary teaching adjustments brought about by the classroom computer age may not be readily recognized in their entirety by professional educators. But, given the

speed at which the technology was marketed upon us, this lack of "adjustment recognition" cannot be unilaterally blamed on faculty.

One may fairly inquire: exactly what teaching adjustments might be required? Merely posing the question is a noteworthy start. The Truth is, we educators have been seriously challenged by the technological advancements of the computer-assisted teaching age; and the technology is here to stay. It is this acceleration of high technology which has led us to perhaps our greatest educational hurdle in decades: how do we ensure that the computer, in all its analytical glory, substantially complements critical thinking?

The paradox is that it is precisely the computer's charm (i.e., speed) that may be its greatest threat to critical thinking. (We might recognize the similar arguments of the late 1960's with regard to pocket calculators in elementary math classrooms.) Curricula have been expanded and, hopefully, improved with the advent of computers, but are we sure about our advancements in the teaching of the thinking process itself?

Today, it is generally quite easy to make courses "computer-assisted"; and what mortal can resist the computer's many attributes? This author's position is that optimum use of any high technology in the curricula must be evaluated by its impact to the critical thinking process.

Critical Thinking

Definitions of "critical thinking" and its importance in education abound; merely a small sampling is presented here. Shallcross (1981) described thinking as "an adventure into the unknown; a trip on which we may let our minds soar freely."

As discussed by McMillen (1986):

> The roots of critical-thinking concepts go back to the Socratic method of inquiry and debate, a model that many faculty members now follow. But recent events, especially the spate of national reports on the deteriorating quality of undergraduate learning, sounded a clear warning to many educators about the need for a renewed attention to the process. (P.24)

Further, the Excellence Report (1983) indicated:

> ....schools may emphasize such rudiments as reading and computation at the expense of other essential skills, such as comprehension. Many 17-year-olds do not possess the higher order intellectual skills we should expect of them. Nearly 40 percent cannot draw inference from written material; only one-fifth can write a persuasive essay; and only one-third can solve a mathematics problem requiring several steps.

Squire (1985) concurs with both McMillen and the Excellence Report, adding that technology in education must be used to strengthen thinking. Hoelscher (1984) stated, "problem-solving is a thinking process. It is a means by which we use previously acquired knowledge and understanding to work through an unfamiliar situation. Through synthesis of this knowledge we apply the process."

It follows that a practical definition of critical thinking might now read: a process in which we synthesize information, induct, and deduct based on a personalized thought process. Rote memorization means little. And in today's age of pragmatic education, few could argue that it is critical thinking, not memorization of facts, that creates the "successful" (wise?) individual.

Computers, if misused, as they easily can be via their innate allure, could clearly work against critical thinking processes. If, however, the computer is utilized optimally, this possibility can be greatly reduced. As reported in studies by Domarin (1982) and Montague (1982), the greatest potential for the classroom computer lies not in the rote-learning process, but rather in the teaching of higher-level thinking skills.

In summary, perhaps the role of the computer in education is best summarized by Hoelscher (1984):

> The computer is a tool with great potential. Much like the performance of a human prodigy, the use of the computer in education is evaluated according to its ability to do what we expect it to do.... As it became clear that there were more interactive applications that could be designed for its use, we raised our level of expectation a few notches. Today, we realize that we have even more areas to explore using this tool. The "burden" of having great potential extends our expectations again and again. (p.1)

From the aforementioned sampling of contemporary literature, it is clear that we must first fully recognize the importance of critical thinking, and, second, better understand the potentials of high technology in education. To accomplish this, we must establish more formalized research directions, but first, where are we at the moment?

Contemporary Research

As conclusively indicated by Hoelscher (1984), Becker (1982), and Rogosta, Holland and Jamison (1982), empirical evidence regarding the effective uses of micro-computers in the classroom is still somewhat lacking or, at best, remains unclear.

Rubin, et. al. (1984) indicated that most educational software severely restricted interaction between student and

computer. Further, the study showed that 60% of the software products available were merely of the "drill and practice" type.

Fortunately, some software, combined with an innovative curriculum, can yield successful results in promoting critical thinking. Pogrow (1985) developed the Higher Order Thinking Skills Project which, utilizing micro-computers in a learning laboratory, promoted student thinking in their constructing of sophisticated associations between ideas.

Bass and Perkins (1984) have statistically demonstrated that computer-assisted instruction, within a nine week project setting, fostered critical thinking skills in verbal analogy and reasoning skills of seventh graders. Additionally, work by Baum (1984) discussed the use of computer-assisted instruction to develop critical thinking in the study of English. An article by Slesnick (1983) described a computer curriculum that was specifically designed to stimulate the development of critical thinking skills among elementary school children. Finally, Chonacky (1982) presented the use of micro-computers in relation to critical thinking as applied to physics.

All of the above studies of computer-assisted instruction are to be applauded, yet consider the scarcity of such research. In a recent ERIC literature search conducted by this author, over 8,000 entries were recognized as "computer-assisted instruction-related" and another 3,000 entries were found regarding "critical thinking." Yet, less than 30 documents were identified as studying both topics in combination. Even more disturbing, of these 30 documents, less than five related research specifically to institutions of higher education!

While research in this area is still in an early and formative stage, would it not help to evaluate the qualities of instructional software in specific reference to their impact on critical thinking? A simple, yet practical, tool for evaluating software in this regard.

Table I — The Critical Thinking-CAI Checklist

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Answer "yes" or "no" to each question regarding the CAI software of your choice. Score one point for each "yes" response.

☐ 1. Do computer assignments act as a STARTING POINT for decision-making, as opposed to yielding final solutions?

☐ 2. Does the computer program FOSTER STUDENT INTERACTION and REACTION in both input and output modes as opposed to simply developing student prowess in keyboard entry of commands?

☐ 3. Assuming time were NOT a factor, could a student successfully complete and understand the lesson WITHOUT computer assistance?

☐ 4. Does the student have ample and significant opportunity to ALTER or RESTRICT the software's capabilities?

☐ 5. Is the student granted an opportunity to interact with the computer in any SPECIFIC DECISION process?

☐ 6. Does the software MOTIVATE STUDENTS into higher levels of thinking (e.g., induction, deduction, synthesize information, analogy study, etc.)?

☐ 7. Does the software emphasize the computer's role as merely a TOOL and not a substitute for decision-making? (This can be a tough one; are you sure?)

☐ 8. Does the software provide sufficient latitude for student CREATIVITY in decision-making and problem solving?

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In this author's informal research using the above checklist, only four of twenty-five sampled CAI software products (24%) yielded scores of three or better from the list of eight questions. Preliminary conclusion: don't expect much of today's CAI software to fair well on the above checklist, most of it won't. The "silver-lining": poor critical thinking-related software is still indirectly valuable to a course if, because of the computer's speed, greater class time is freed; time in which other critical thinking exercises might be employed.

The above checklist may help keep us in the right general direction; but, as astutely stated by Dr. Robert Ennis (1986) with regard to computer assisted instruction and critical thinking, "people are looking for a quick fix, something they can learn in a day or two to plug into their courses. But it can't be done quickly. It takes a tremendous amount of rethinking and adjustment." In the hope of easing this transitional period, the following suggestions are offered to higher educators.

Suggestions for the Future

Based on both primary and secondary literature and research, the following points are suggested for consideration by the collegiate community:

1. Greater dissemination of information, including debate, is needed regarding, first, the defining and second, the teaching of the critical thinking process.

2. As evidenced by the review of literature, much more research needs to be done investigating computer-assisted instruction and critical thinking interactions. This is particularly true at the college level of instruction.

3. Evaluation of software must include its effects on the critical thinking process (perhaps per the CAI checklist or a similar instrument).

4. Academicians must stay optimistic regarding the uses of computer assisted instruction in complementing critical thinking skills. Included with this positive outlook must be a willingness to accept, with educated caution, high technology as a significant, even essential, tool in modern teaching.

We must recognize that the key to the computer's optimum uses as an instruction tool lies solely within the practices of the informed teacher. Considering the extreme importance of critical thinking and its integration with the computer's staggering power, higher educators must be

sensitized to both the potential dangers and grand rewards of the synergy. Due to the advent of high technology in the classroom, the challenge in teaching critical thinking has never been greater than it is today.

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